

Patent Claims

1. Internal combustion engine, especially Diesel engine, with
  - an exhaust gas line (2) in which an NO<sub>x</sub> reduction catalytic converter (3) is arranged; and with
  - a reducing agent-generating unit (20) for the generation of H<sub>2</sub>-containing and NH<sub>3</sub>-containing reducing gas, which can be added upstream of the NO<sub>x</sub> reduction catalytic converter (3) in the exhaust gas line (2), whereby the reducing agent-generating unit (20) can be supplied with an HC-containing fuel, as well as air, and/or exhaust gas,  
c h a r a c t e r i z e d i n t h a t  
the reducing agent-generating unit (20) has an NO<sub>x</sub> generation step (22), and an H<sub>2</sub> generation step (21; 25) in serial arrangement.
2. Internal combustion engine according to claim 1,  
c h a r a c t e r i z e d i n t h a t the NO<sub>x</sub> generation step (22) is arranged downstream from the H<sub>2</sub> generation step (21; 25).
3. Internal combustion engine according to claim 1,  
c h a r a c t e r i z e d i n t h a t the NO<sub>x</sub> generation step (22) is arranged upstream from the H<sub>2</sub> generation step (21; 25).
4. Internal combustion engine according to one of the claims 1 to 3,  
c h a r a c t e r i z e d i n t h a t the NO<sub>x</sub> generation step (22) is arranged downstream from the NH<sub>3</sub> generation step (24; 25; 26).
5. Internal combustion engine according to one of the preceding claims,  
c h a r a c t e r i z e d i n t h a t a fractioning unit (27) is arranged to the reducing agent-generating unit (20) in such a way that low-boiling components of a fuel used for the operation of the internal combustion engine (1) can be separated by the fractionation unit (27), which can be supplied to the H<sub>2</sub> generation step (21; 25).
6. Internal combustion engine according to one of the preceding claims,

characterized in that the reducing agent-generating unit (20) can be operated alternately in two operating modes in such a way, that during the first operating mode of the  $\text{NO}_x$  generation step (22), an  $\text{NO}_x$ -containing gas can be produced, and in the second operation mode, an  $\text{H}_2$ -containing and  $\text{NH}_3$ -containing reducing gas can be produced by the reducing agent-generating unit (20).

7. Internal combustion engine according to claim 6,

characterized in that an  $\text{NO}_x$  intermediate storage unit (23; 26) is arranged downstream from the  $\text{NO}_x$  generation step (22).

8. Internal combustion engine according to claim 7,

characterized in that the  $\text{NO}_x$  intermediate storage unit (26) is designed for the reaction of stored  $\text{NO}_x$  with  $\text{H}_2$  to  $\text{NH}_3$ .

9. Internal combustion engine according to one of the claims 3 to 5,

characterized in that the  $\text{H}_2$  generation step (21; 25) is designed for the reaction of supplied  $\text{NO}_x$  into  $\text{NH}_3$ .

10. Internal combustion engine according to one of the preceding claims,

characterized in that the  $\text{NO}_x$  generation step (22) is designed for the generation of  $\text{NO}_x$  from air and/or oxygen-containing exhaust gas.

11. Internal combustion engine according to one of the preceding claims,

characterized in that the  $\text{NO}_x$  reduction catalytic converter (3) has a denox catalytic converter step (3b) for the reaction of  $\text{NO}_x$  with  $\text{H}_2$ , and an SCR catalytic converter step (3a) for the reaction of  $\text{NO}_x$  with  $\text{NH}_3$ .

12. Procedure for the operation of an internal combustion engine, especially a Diesel engine, with

- a reducing agent-generating unit (20), and with
- an exhaust gas line (2) in which an  $\text{NO}_x$  reduction catalytic converter (3) is arranged, whereby a reducing gas produced by the reducing agent-generating unit (20) is added upstream from the  $\text{NO}_x$  reducing catalytic converter (3) to the exhaust gas,

characterized in that

the reducing gas generation comprises the following generation steps:

a) Generation of an  $\text{NO}_x$ -containing gas from an  $\text{NO}_x$  generation step (22) allocated to the reducing agent-generating unit (20) from the air and/or exhaust gas supplied to the  $\text{NO}_x$  generation step (22);

b) Intermediate storage of  $\text{NO}_x$  when conducting the  $\text{NO}_x$ -containing gas produced in operation a through an  $\text{NO}_x$  intermediate storage unit (23; 26), which is arranged downstream from the  $\text{NO}_x$  generation step (22), and arranged to the reducing agent-generating unit (20);

c) Generation of an  $\text{H}_2$ -containing gas by an  $\text{H}_2$  generation step (21) allocated to the reducing agent-generating unit (20), and arranged downstream from the intermediate storage unit (23; 26), from the fuel, as well as air, and/or exhaust gas supplied to the  $\text{H}_2$  generation step (21);

d) Reaction of  $\text{NO}_x$  stored in the  $\text{NO}_x$  intermediate storage unit (23; 26) with the gas produced in operating c into  $\text{NH}_3$ , so that an  $\text{H}_2$ -containing, and  $\text{NH}_3$ -containing reducing gas is produced;

whereby the operations a and b are performed alternately with the operations c and d.

13. Procedure for the operation of an internal combustion engine, especially a Diesel engine, with

– a reducing agent-generating unit (20), and with

– an exhaust gas line (2) in which an  $\text{NO}_x$  reduction catalytic converter (3) is arranged,

whereby a reducing gas produced by the reducing agent-generating unit (20) is added upstream of the  $\text{NO}_x$  reducing catalytic converter (3) to the exhaust gas,

characterized in that the

reducing gas generation consists of the following generation steps:

a) Generation of an  $\text{NO}_x$ -containing gas from an  $\text{NO}_x$  generation step (22) allocated to the reducing agent-generating unit (20) from the air, and/or exhaust gas supplied to the  $\text{NO}_x$  generation step (22);

b) Generation of an  $\text{H}_2$ -containing and an  $\text{NH}_3$ -containing reducing gas from an  $\text{H}_2$  generation step (21) allocated to the reducing agent-generating unit (20), and arranged downstream from the  $\text{NO}_x$  generation step (21) from  $\text{NO}_x$  supplied to the  $\text{H}_2$  generation step (21) containing gas produced in operation a, supplied fuel, as well as air, and/or exhaust gas;

14. Procedure according to claim 12,

characterized in that the  $\text{NO}_x$  reaction into  $\text{NH}_3$  takes place in the catalytic  $\text{NH}_3$  generation step (24), which is arranged to the reducing agent generation unit (20), and arranged downstream to the  $\text{NO}_x$  intermediate storage unit (24).

15. Procedure according to claim 12,  
c h a r a c t e r i z e d i n t h a t the NO<sub>x</sub> intermediate storage of NO<sub>x</sub>, and the NO<sub>x</sub> reaction into NH<sub>3</sub> is performed with a catalytic NO<sub>x</sub> intermediate storage unit (26).
16. Procedure according to one of the claims 12 to 15,  
c h a r a c t e r i z e d i n t h a t in a fractioning unit (27) allocated to the reducing agent-generating unit (20) a fuel enriched with low-boiling components is obtained in a fractionating unit (27) allocated to the reducing agent-generating unit (20), which is supplied to the reducing agent-generating unit (20) for the generation of reducing gas.
17. Procedure according to one of the claims 12 to 16,  
c h a r a c t e r i z e d i n t h a t the NO<sub>x</sub> reducing catalytic converter (3) is divided into a denox catalytic converter step (3b) for the reaction of NO<sub>x</sub> with H<sub>2</sub>, and into an SCR catalytic converter step (3a) for the reaction of NO<sub>x</sub> with NH<sub>3</sub>, and the reducing gas is supplied to the exhaust gas as a function of its composition at the input side to the SCR catalytic converter step (3a), or on the input side to the denox catalytic converter step (3b).
18. Procedure according to one of the claims 12 to 17,  
c h a r a c t e r i z e d i n t h a t the amount and/or the composition of the reducing gas produced by the reducing agent-generating unit is set as a function of the operating status of the internal combustion engine.